

CLAIMS

1. A terminal in a wireless multiple-input multiple-output (MIMO) communication system, comprising:
 - a mode selector operable to select a spatial multiplexing mode from among a plurality of spatial multiplexing modes supported by the terminal, wherein each of the plurality of spatial multiplexing modes supports simultaneous transmission of multiple data symbol streams via multiple spatial channels of a MIMO channel formed with a plurality of antennas at the terminal;
 - a transmit spatial processor operable to spatially process a first plurality of data symbol streams in accordance with the selected spatial multiplexing mode to obtain a plurality of transmit symbol streams for transmission from the plurality of antennas and via a first communication link; and
 - a receive spatial processor operable to spatially process a plurality of received symbol streams, obtained from the plurality of antennas, in accordance with the selected spatial multiplexing mode to obtain a plurality of recovered data symbol streams, which are estimates of a second plurality of data symbol streams sent via a second communication link.
2. The terminal of claim 1, wherein the plurality of spatial multiplexing modes include a steered mode and a non-steered mode.
3. The terminal of claim 2, wherein the steered mode supports simultaneous transmission of multiple data symbol streams via multiple orthogonal spatial channels of the MIMO channel, and wherein the non-steered mode supports simultaneous transmission of multiple data symbol streams from the plurality of antennas.

4. The terminal of claim 2, wherein
the transmit spatial processor is operable to multiply the first plurality of data symbol streams with a matrix of steering vectors for the steered mode and with an identity matrix for the non-steered mode, and
the receive spatial processor is operable to multiply the plurality of received symbol streams with a matrix of eigenvectors for the steered mode and with a spatial filter matrix for the non-steered mode.

5. The terminal of claim 4, further comprising:
a channel estimator operable to estimate a channel response of the second communication link; and
a controller operable to derive the spatial filter matrix based on the estimated channel response for the second communication link.

6. The terminal of claim 5, wherein the controller is operable to derive the spatial filter matrix based on a channel correlation matrix inversion (CCMI) technique or a minimum mean square error (MMSE) technique.

7. The terminal of claim 5, wherein the controller is operable to derive the spatial filter matrix based on a successive interference cancellation (SIC) technique and using a channel correlation matrix inversion (CCMI) technique or a minimum mean square error (MMSE) technique.

8. The terminal of claim 2, further comprising:
a transmit data processor operable to code and modulate a first plurality of data streams in accordance with a first plurality of rates to obtain the first plurality of data symbol streams for the first communication link; and
a receive data processor operable to demodulate and decode the plurality of recovered data symbol streams in accordance with a second plurality of rates to obtain a plurality of decoded data streams for the second communication link.

9. The terminal of claim 8, wherein the first plurality of rates are for a plurality of eigenmodes of the MIMO channel for the steered mode and are for the plurality of antennas for the non-steered mode.

10. The terminal of claim 2, wherein the mode selector is operable to select the steered mode if the terminal is calibrated and the non-steered mode if the terminal is not calibrated, and wherein channel response of the second communication link is reciprocal of channel response of the first communication link if the terminal is calibrated.

11. The terminal of claim 2, wherein the mode selector is operable to select the steered mode or the non-steered mode based on an amount of data to send, channel conditions, capability of an entity in communication with the terminal, or a combination thereof.

12. The terminal of claim 2, wherein the mode selector is operable to select the non-steered mode for a first portion of a data session and to select the steered mode for a remaining portion of the data session.

13. The terminal of claim 2, wherein the mode selector is operable to select the steered mode or the non-steered mode based on received signal-to-noise-and-interference ratio (SNR).

14. The terminal of claim 2, wherein the transmit spatial processor is further operable to multiplex a steered pilot for the steered mode and an unsteered pilot for the non-steered mode, wherein the steered pilot is transmitted on eigenmodes of the MIMO channel, and wherein the unsteered pilot comprises a plurality of orthogonal pilot transmissions from the plurality of antennas.

15. The terminal of claim 2, wherein the transmit spatial processor is further operable to multiplex an unsteered pilot for both the steered and non-steered modes, and wherein the unsteered pilot comprises a plurality of orthogonal pilot transmissions from the plurality of antennas.

16. The terminal of claim 1 and operable to communicate with an access point in the MIMO system.

17. The terminal of claim 1 and operable to communicate peer-to-peer with another terminal in the MIMO system.

18. The terminal of claim 1, wherein the MIMO system utilizes orthogonal frequency division multiplexing (OFDM), and wherein the transmit and receive spatial processors are operable to perform spatial processing for each of a plurality of subbands.

19. The terminal of claim 1, wherein the MIMO system is a time division duplex (TDD) system.

20. A method of processing data in a wireless multiple-input multiple-output (MIMO) communication system, comprising:

selecting a spatial multiplexing mode from among a plurality of spatial multiplexing modes, wherein each of the plurality of spatial multiplexing modes supports simultaneous transmission of multiple data symbol streams via multiple spatial channels of a MIMO channel;

spatially processing a first plurality of data symbol streams in accordance with the selected spatial multiplexing mode to obtain a plurality of transmit symbol streams for transmission from a plurality of antennas and via a first communication link; and

spatially processing a plurality of received symbol streams, obtained from the plurality of antennas, in accordance with the selected spatial multiplexing mode to obtain a plurality of recovered data symbol streams, which are estimates of a second plurality of data symbol streams sent via a second communication link.

21. The method of claim 20, wherein the plurality of spatial multiplexing modes include a steered mode and a non-steered mode, the steered mode supporting simultaneous transmission of multiple data symbol streams via multiple orthogonal spatial channels of the MIMO channel, and the non-steered mode supporting simultaneous transmission of multiple data symbol streams from the plurality of antennas.

22. The method of claim 21, wherein the first plurality of data symbol streams are multiplied with a matrix of steering vectors for the steered mode and with an identity matrix for the non-steered mode, and wherein the plurality of received symbol streams are multiplied with a matrix of eigenvectors for the steered mode and with a spatial filter matrix for the non-steered mode.

23. The method of claim 22, further comprising:
estimating a channel response of the second communication link; and
deriving the spatial filter matrix based on the estimated channel response for the second communication link.

24. The method of claim 23, wherein the spatial filter matrix is derived based on a channel correlation matrix inversion (CCMI) technique, a minimum mean square error (MMSE) technique, or a successive interference cancellation (SIC) technique.

25. An apparatus in a wireless multiple-input multiple-output (MIMO) communication system, comprising:

means for selecting a spatial multiplexing mode from among a plurality of spatial multiplexing modes, wherein each of the plurality of spatial multiplexing modes supports simultaneous transmission of multiple data symbol streams via multiple spatial channels of a MIMO channel;

means for spatially processing a first plurality of data symbol streams in accordance with the selected spatial multiplexing mode to obtain a plurality of transmit symbol streams;

means for transmitting the plurality of transmit symbol streams from a plurality of antennas and via a first communication link;

means for receiving a plurality of received symbol streams from the plurality of antennas for a second communication link; and

means for spatially processing the plurality of received symbol streams in accordance with the selected spatial multiplexing mode to obtain a plurality of recovered data symbol streams, which are estimates of a second plurality of data symbol streams sent via the second communication link.

26. The apparatus of claim 25, wherein the plurality of spatial multiplexing modes include a steered mode and a non-steered mode, the steered mode supporting simultaneous transmission of multiple data symbol streams via multiple orthogonal spatial channels of the MIMO channel, and the non-steered mode supporting simultaneous transmission of multiple data symbol streams from the plurality of antennas.

27. The apparatus of claim 26, wherein the first plurality of data symbol streams are multiplied with a matrix of steering vectors for the steered mode and with an identity matrix for the non-steered mode, and wherein the plurality of received symbol streams are multiplied with a matrix of eigenvectors for the steered mode and with a spatial filter matrix for the non-steered mode.

28. The apparatus of claim 27, further comprising:
means for estimating a channel response of the second communication link; and
means for deriving the spatial filter matrix based on the estimated channel response for the second communication link.

29. The apparatus of claim 28, wherein the spatial filter matrix is derived based on a channel correlation matrix inversion (CCMI) technique, a minimum mean square error (MMSE) technique, or a successive interference cancellation (SIC) technique.

30. An access point in a wireless multiple-input multiple-output (MIMO) communication system, comprising:

a mode selector operable to select a spatial multiplexing mode from among a plurality of spatial multiplexing modes supported by the access point, wherein each of the plurality of spatial multiplexing modes supports simultaneous transmission of multiple data symbol streams via multiple spatial channels of a MIMO channel formed with a plurality of antennas at the access point;

a transmit spatial processor operable to spatially process a first plurality of data symbol streams in accordance with the selected spatial multiplexing mode to obtain a plurality of transmit symbol streams for transmission from the plurality of antennas and via a first communication link; and

a receive spatial processor operable to spatially process a plurality of received symbol streams, obtained from the plurality of antennas, in accordance with the selected spatial multiplexing mode to obtain a plurality of recovered data symbol streams, which are estimates of a second plurality of data symbol streams sent via a second communication link.

31. The access point of claim 30, wherein the plurality of spatial multiplexing modes include a steered mode and a non-steered mode.

32. The access point of claim 31, wherein

the transmit spatial processor is operable to multiply the first plurality of data symbol streams with a matrix of steering vectors for the steered mode and with an identity matrix for the non-steered mode, and

the receive spatial processor is operable to multiply the plurality of received symbol streams with a matrix of eigenvectors for the steered mode and with a spatial filter matrix for the non-steered mode.